NASA TECHNICAL TRANSLATION NASA TT F-15938

ACOUSTICAL TESTS AT THE CENTER FOR TESTING OF PROPULSION SYSTEMS

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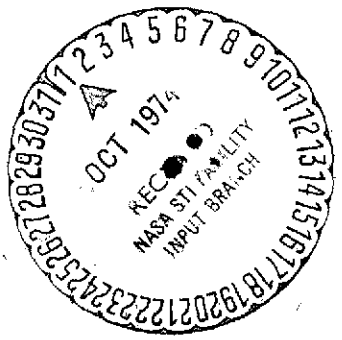
(NASA-TT-F-15938) ACOUSTICAL TESTS AT THE CENTER FOR TESTING OF PROPULSION SYSTEMS (Kanner (Leo) Associates) 6 p HC $4.00 CSCL 14B G3/11

N74-32723 Unclas 48057

Translation of "Essais Acoustiques au C.E.Pr.," Centre d'Essais des Propulseurs, Saclay, France, Report 78/ZDL/74, August 9, 1974, 4 pp.



NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
WASHINGTON, D.C. 20546 SEPTEMBER 1974

STANDARD TITLE PAGE

1. Report No.	2. Government Accession No.	3. Recipient's Catalog No.
NASA TT F-15938		

4. Title and Subtitle	5. Report Date
ACOUSTICAL TESTS AT THE CENTER FOR TESTING OF PROPULSION SYSTEMS	September 1974
	6. Performing Organization Code

7. Author(s)	8. Performing Organization Report No.
J. Bongrand, Weapons Engineer, Center for Testing of Propulsion Systems, Saclay, France	
	10. Work Unit No.

9. Performing Organization Name and Address	11. Contract or Grant No.
Leo Kanner Associates Redwood City, CA 94063	NASw-2481
	13. Type of Report and Period Covered
	Translation
12. Sponsoring Agency Name and Address	14. Sponsoring Agency Code
National Aeronautics and Space Administration, Washington, D.C. 20546	

15. Supplementary Notes

Translation of "Essais Acoustiques au C.E.Pr.," Centre d'Essais des Propulseurs, Saclay, France, Report 78/ZDL/74, August 9, 1974, 4 pp.

16. Abstract

Tests performed primarily in the A17 anechoic chamber include measurement of the sound field and frequency spectra, comparison of sound levels and other physical parameters representative of turbulence, analysis of the efficiency of several types of noise suppressors, use of specialized methods to pinpoint sound sources within the jet, etc.

17. Key Words (Selected by Author(s))	18. Distribution Statement
	Unclassified-Unlimited

19. Security Classif. (of this report)	20. Security Classif. (of this page)	21. No. of Pages	22. Price
Unclassified	Unclassified	4	

ACOUSTICAL TESTS AT THE CENTER FOR TESTING OF PROPULSION SYSTEMS

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1. General Remarks

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1.1. Clients

The Center for Testing of Propulsion Systems performs tests for a large number of organizations. Most important, perhaps, is SNECMA [Société Nationale d'Etudes et de Construction des Moteurs d'Avions; National Association of Aircraft Study and Engine Design], especially under the Concorde program, but also for general research. Other associations (the SNIAS) and research organizations such as ONERA [Office national d'Etudes et de Recherches Aérospatiales; National Office of Aerospace Study and Research] also use the A17 anechoic chamber.

In addition we might mention instrument designers (Wonder, Thomson, CSF, etc.) who test their equipment in the A12 noise cells to determine the behavior of this equipment in a sound medium. This, however, is a minor activity.

1.2. Measurements Performed

These are usually limited to the sound field and the frequency spectra at various points. Since microphones are able to operate in three dimensions, they are generally used on a 6 m circle with its radius centered on the model (azimuthal examination of the far field).

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*Numbers in the margin indicate pagination in the foreign text.

Comparison of the sound level and other physical parameters representative of the turbulence in the jet (obtained by infrared radiometer or by hot wire) permits a more thorough exploitation of the results.

In another connection, noise suppressor studies in the anechoicechamber are complemented by effective cross-section and thrust loss measurements performed at the A04 bench.

2. Types of Tests

Unlike the types of measurements, the configurations of the models tested and their operating conditions vary a great deal from one test to the next and during single tests. Several categories may be distinguished.

2.1. "Empirical" Tests

Usually it is considered sufficient to study the sound field produced by a model for the single purpose of predicting the noise generated by the model in full scale. Thus;

-- The noise of a jet from a converging pipe has been studied /3 systematically by varying the expansion ratio, temperature and cross-section at the neck. The results made it possible to set up empirical formulas for the jet noise.

-- The efficiency of a large number of noise suppressors (especially those designed for the Concorde engines) has been tested. By way of example we might mention:

-- Shovel noise suppressors
-- Upstream neck noise suppressors (in collaboration with the NGTE)
-- The effect of a rear body

-- Corrugated noise suppressors
-- Multiple tube and hole noise suppressors
-- Slotted jet pipes

-- Measurements have been made of the noise generated by an airstream in a conduit lined with various types of ventilated or non-ventilated soundproofing.

-- The sound field produced by a jet in the presence of flaps (blowing effect encountered with the ADAC) has been examined.

2.2. Tests Including a Research Part

A judicious choice of model and measurements conditions may permit a more analytic approach to the phenomena than in the preceding cases. For example:

-- Tests were performed to see whether a plate located in the plane of symmetry of two jet pipes made it possible to simulate the second pipe (as in aerodynamics). The results were always negative due to the interaction between the plate and the jet.

-- The use of a screen close to the pipe furnished useful information on the positions of sound sources in the jet.

-- To study the application of the masking effect of one jet by another with a multi-hole pipe, the noise from only the outer holes was measured, the others being plugged.

-- The use of a discrete frequency generator simulating the internal noise permitted accomparison of the influence of a given phenomenon on the various sound sources.

2.3, Current Trends /4

Two of the types of tests performed recently seem to be especially promising.

-- Measurements of the infrared-sound correlation are included in current research on turbulence and the mechanics of noise generation in jets.

-- Use of the secondary air input of the A17 chamber (usually used as a feed to models with double flux pipes) to simulate the external airstream when the airplane is in flight have yielded initial results which are not consistently conclusive. The occurrence of parasitic valve noise and the excessively small ratio of the cross-sections of the external airstream and the jet might explain some discrepancies. However, this field of research still appears to be highly important.

3. Conclusion

The anechoice chamber is being used both in the area of development (prediction of noise from noise suppressors) and for various types of research (detailed study of jet noise and turbulence). Its main deficiency is its incapacity to supply information on the effect of a sound source in motion.